PUMPS

Filed Sept. 4, 1957 2 Sheets-Sheet 1

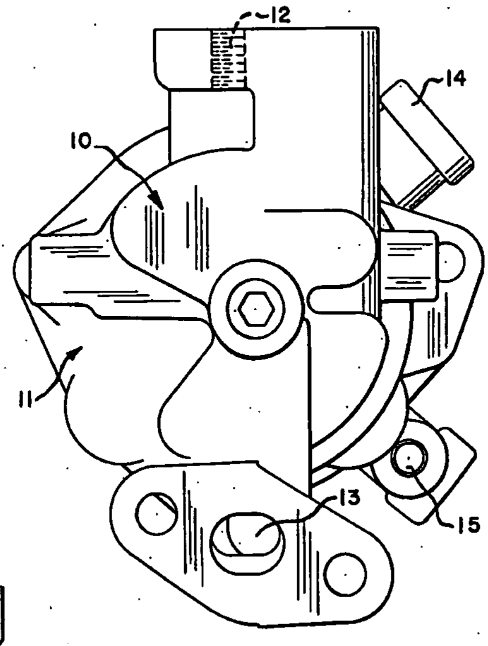


FIG. 1

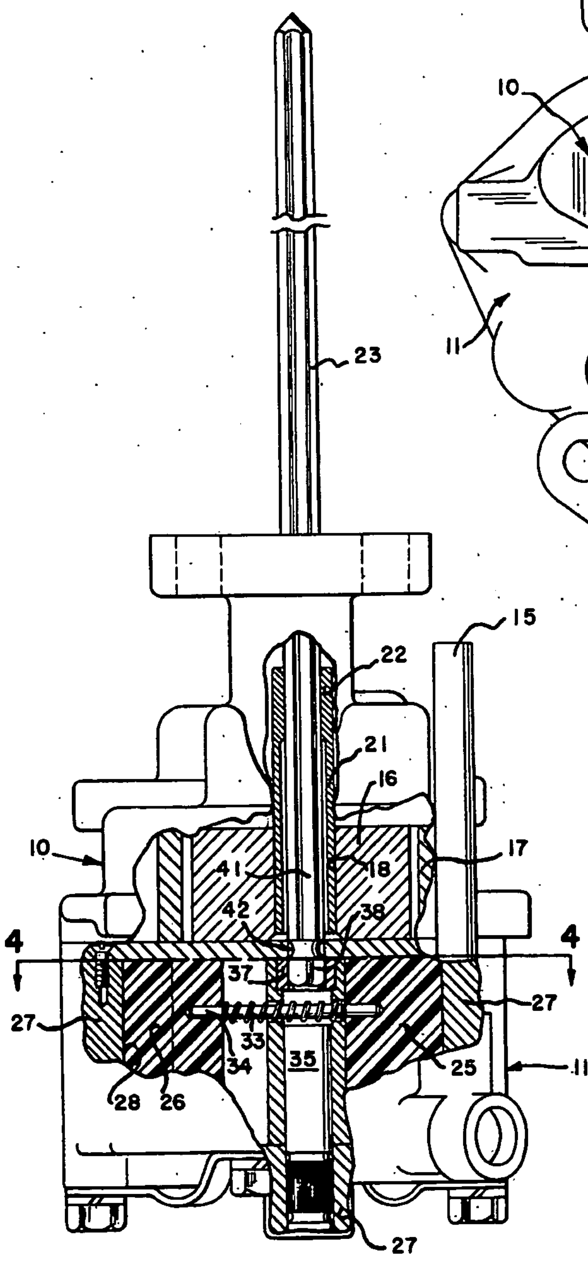


FIG. 2

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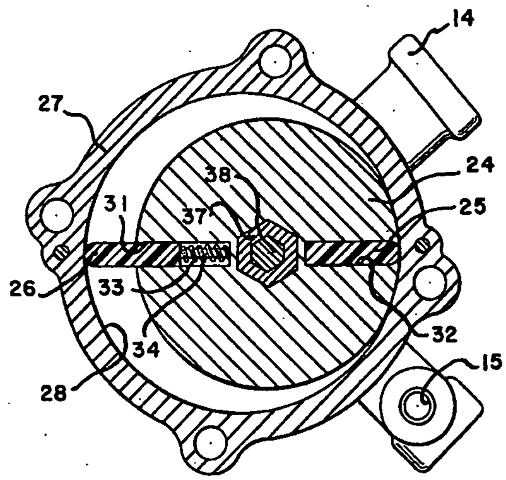


FIG. 4

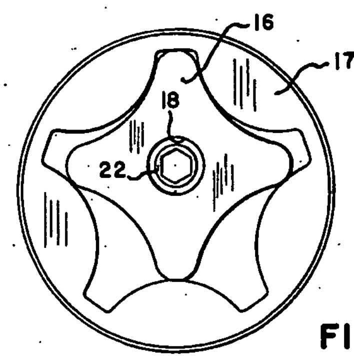


FIG. 3

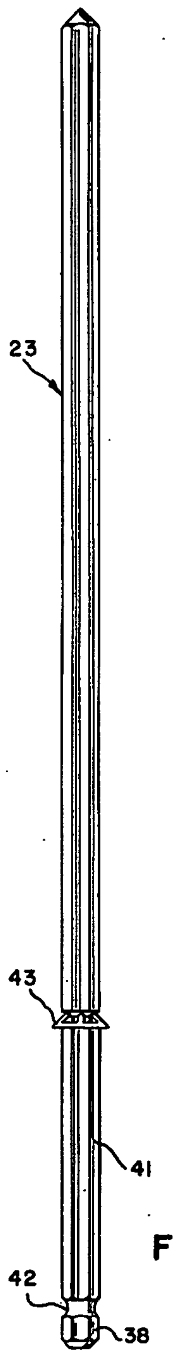


FIG. 5

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# PUMPS

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This invention relates to pumps and pumping mechanisms and more particularly to a pumping mechanism in which a pump having high amplitude, low frequency pulsating flow characteristic and another driven means are driven by a common shaft. Although not so limited, the present invention contemplates the mounting of a pump of the rotary type having cooperating internal and external rotors with intermeshing lobes, for example, a gerotor on the same shaft as a pump of the vane type. Such an assembly is ideally suited as a combination oil pump for engine lubrication and vacuum pump for use in operating windshield wipers, with the rotary pump serving as the oil pump and the vane pump serving as the vacuum pump.

A well known characteristic of this type of rotary pump is the high amplitude, low frequency pulsating flow delivery caused by finite amounts of fluid being trapped between the lobes of the inner and outer rotors and then delivered to the outlet of the pump. High pressures are developed in the pump and then suddenly relieved as the pump delivers the finite amount of fluid trapped between the lobes of the inner and outer rotors to the pump outlet. Such increases and decreases of pressure inside the pump cause a transient oscillating motion to be superimposed upon the steady state rotary motion of the rotors caused by its driving means.

If a second pump or other driven means having substantial rotational inertia were attached to the rotor of the rotary pump by means of a key or other short shaft, the transient oscillations of the driven rotor will cause severe torsional stresses to be produced within the key or short shaft resulting in fatigue failure, thereby rendering the second pump or other driven means inoperative.

This invention seeks to avoid difficulties of the above mentioned nature by providing a relatively long resilient drive shaft which is fixed to the driven member of the pump having high amplitude, low frequency pulsating flow characteristic, for example, the internal rotor of a rotary pump, at a considerable distance axially from the point on the shaft where the other driven means, for example, the rotor of a vane pump, is affixed. This provides a means of energy storage for the forces created by the oscillations of the driven member of the pump having the pulsating flow characteristic, of sufficient resiliency to absorb these oscillations repeatedly without fatigue failure. Thus, the portion of the shaft between which the two members are fastened winds and unwinds, so to speak, as the pulsations are delivered to it by the driven member of the pump having the pulsating flow characteristic and simultaneously drives the second driven means.

Accordingly, an object of the present invention is the provision of a resilient drive shaft having a driven member of a pump having high amplitude, low frequency pulsating flow characteristic affixed thereto at a substantial distance axially from a point where another driven means is affixed.

Another object of the invention is to provide a driven member of a pump having high amplitude, low frequency pulsating flow characteristic and another driven means mounted for actuation upon a common torsionally resilient shaft at such a distance axially from each other on the shaft that the oscillations produced by the driven member of the pump can be taken up by the length of shaft between the two members.



A further object of the invention is to provision of a rotary oil pump for an internal combustion engine and a vacuum pump for the operation of windshield wipers mounted for actuation on a common shaft thereby effecting a saving in space and materials.

Other objects and attendant advantages will become apparent as the specification is considered in conjunction with the accompanying drawings which show a preferred embodiment of the present invention in which:

FIGURE 1 is a top plan view of two pumps incorporating the driving means of the present invention;

FIGURE 2 is an elevational view of the pumps shown in FIGURE 1 a portion of which is in section;

FIGURE 3 is a top plan view of the rotor assembly of the rotary pump;

FIGURE 4 depicts a top plan view of the vane pump taken along the lines 4—4 of FIGURE 1; and,

FIGURE 5 shows an elevational view of the shaft of the present invention.

Referring now to the drawings in which like reference numerals designate like parts throughout the several views thereof, there is shown in FIGURES 1 and 2, which illustrate a preferred embodiment of the invention, a rotary pump mechanism generally designated by the numeral **10** and a vane type pump mechanism generally designated by the numeral **11**. The rotary pump has an inlet and outlet designated by the numerals **12** and **13** respectively, while the vane pump has an inlet and outlet designated by the numerals **14** and **15** respectively. When the invention is employed in an internal combustion engine as a combination oil pump and vacuum pump, the inlet **12** of the rotary pump is connected to receive oil from the oil pan and the outlet **13** is connected to redeliver the oil to the engine under pressure, while the vane pump inlet **14** is connected to the windshield wiper system of the automobile and the outlet **15** is open to the atmosphere to serve as an exhaust port for the pump.

The rotary pump mechanism **10** may be of conventional construction employing a driven member, for example, inner rotor **16** having one less tooth than the outer rotor **17**. The inner rotor **16** is provided with a bore **18** into which is fitted a sleeve **21** having a portion **22** which is adapted to receive drive member or shaft **23**. The sleeve **21** is affixed to the inner rotor **16** for rotation therewith. It will be noted from FIGURE 1 that the portion **22** is positioned a considerable distance above the rotor **16** and that the internal diameter of the sleeve **21** below the portion **22** is considerably greater than the maximum diameter of the shaft **23**, so that the rotor **16** is driven by the shaft **23** only at that point where the portion **22** of the sleeve **21** engages the shaft.

The vane pump mechanism employs a driven means, for example, a rotor **24** having a pair of vanes **25** and **26** and the rotor is eccentrically mounted in the housing **27** which has a central bore **28**. The vanes are constructed of a graphite base composition bonded by a resin and are positioned in slots **31** and **32** in the rotor **24**. The edges of the vanes are urged against the bore **28** by means of a helical spring **33** mounted on a shaft **34** which extends into the vanes and through the center of the rotor **24** and above the shaft **35** upon which the rotor **24** is rotationally mounted. This shaft is affixed to the lower portion of the housing **27**, for example, the housing **27** may be cast around the shaft **35**. The rotor **24** is provided with a nut **37** preferable having a hexagonal shape both externally and internally. The nut is press fitted into the material of the rotor **24** and is adapted internally to receive the end of the shaft **23**.

Referring now to FIGURE 5, the shaft **23** is shown in

detail and comprises an end portion 38 separated from the main body of the shaft 41 by a portion of reduced diameter 42. There is also provided a skirt 43 adapted to fit in a second portion of reduced diameter. The shaft is preferably made from a metal exhibiting high torsional resiliency and high resistance to fatigue failure. For example, a case hardened steel such as SAE 1030 is ideally suited for construction of this shaft.

The end 38 of the shaft 23 is positioned in the internal portion of the nut 37 with the portion of reduced diameter 42 extending just above the nut. The shaft 23 also extends through the sleeve 21 and engages the portion 22 of said sleeve. Thus, it is readily apparent that the shaft is coupled to the internal rotor 16 of the rotary pumping mechanism by means of portion 22 of sleeve 21, and to the rotor 24 of the vane pump by means of the nut 37.

The drive shaft 23 can be driven by any power means but in the application where the rotary pump is utilized as an oil pump and the vane pump is utilized as a vacuum pump to operate windshield wipers, the shaft can conveniently be driven by the distributor gearing of the internal combustion engine upon which it is mounted.

In the operation of the device, the shaft 23 is driven by a source of power, such as the distributor gearing thereby imparting a steady state rotation to the shaft 23 which in turn imparts a steady state rotation to the internal rotor 16 and the external rotor 17 of the rotary pump and the rotor 24 of the vane pump. Both of these pumps therefore operate to bring fluids into their respective inlets and to discharge the fluids from their respective outlets. Superimposed upon the steady state rotation of the internal rotor 16 and the external rotor 17 is a transient oscillatory motion caused by the high amplitude, low frequency pulsating nature of the pumping action of the rotary pump. The vane type pump on the other hand is characterized by a relatively steady flow when used as a vacuum pump for a windshield wiper mechanism at it is pumping air, a compressible fluid.

Mounting these two pumps on a common shaft results in a saving of space and material with an attendant cost reduction. However, the connection (drive shaft 23) between these two pumps must be capable of absorbing the energy created by the transient oscillatory motion of the rotors of the rotary pump.

The comparatively long torsionally resilient shaft 23 is ideally suited to absorb this energy as it is capable of torsional flexure of sufficient degree to provide a proper connection between the two pumps without danger of failure due to fatigue. As can readily be appreciated by reference to FIGURE 1, the connection of the internal rotor 16 to the shaft 23 by means of the portion 22 of the sleeve 21 is spaced a considerable distance axially from the connection of the rotor 24 to the end 38 of the shaft 23 by means of the nut 37. This permits the torsionally resilient shaft 23 to flex torsionally between these two connections so that the energy difference between the internal rotor 16 of the rotary pump and the rotor 24 of the vane pump caused by the transient oscillatory motion of the internal rotor of the rotary pump can be readily absorbed without danger of fatigue failure of the connection.

The reduced portion 42 of the shaft 23 provides a safety feature, for if the shaft 23 fails due to the torsion described above, it will fail at this point where the shaft has the least cross-sectional area. This insures the proper operation of the rotary pump, which, when used as the oil pump of an internal combusition engine, is critical, for the oil pump of the engine must be kept in operation even though the shaft may fail at the point 42. The sleeve 43 prevents the shaft 23 from moving down against the spring system 33 as it abuts the top of the portion 22 of the sleeve 21.

Thus the present invention provides a simple, inexpensive and reliable common drive for a pump having



pulsating flow characteristics and another driven means.

We claim as our invention:

1. In a pumping mechanism, a positive displacement fluid pump having high amplitude, low frequency pulsating flow characteristics, said fluid pump having a driven member, said driven member having a bore positioned therein, a sleeve positioned in said bore and affixed to said driven member, a rotatable torsionally resilient drive shaft affixed to said sleeve a substantial distance from one end of said torsionally resilient drive shaft, a source of power operatively connected to said torsionally resilient drive shaft at a point axially spaced from said sleeve for causing said torsionally resilient drive shaft to rotate, said fluid pump imparting an oscillatory motion to said driven member aid to said torsionally resilient drive shaft when in operation to impose an oscillatory motion upon its rotary motion, a drive means affixed to said one end of said torsionally resilient drive shaft and adapted to be driven thereby, the distance between the point where said sleeve is affixed to said torsionally resilient drive shaft and said one end and the torsional resiliency of said torsionally resilient drive shaft being sufficient to absorb substantially all of the pulsating energy which may be imparted to said torsionally resilient drive shaft by the oscillatory motion of said driven member.

2. In a pumping mechanism, a positive displacement fluid pump having high amplitude, low frequency pulsating flow characteristics, said fluid pump having a driven member, said driven member having a bore positioned therein, a sleeve positioned in said bore and affixed to said driven member, a rotatable torsionally resilient drive shaft affixed to said sleeve a substantial distance from one end of said torsionally resilient drive shaft, a source of power operatively connected to said torsionally resilient drive shaft at a point axially spaced from said sleeve for causing said torsionally resilient drive shaft to rotate, said fluid pump imparting an oscillatory motion to said driven member and to said torsionally resilient drive shaft when in operation to impose an oscillatory motion upon its rotary motion, a driven means affixed to said one end of said torsionally resilient drive shaft and adapted to be driven thereby, the distance between the point where said sleeve is affixed to said torsionally resilient drive shaft and said one end and the torsional resiliency of said torsionally resilient drive shaft being sufficient to absorb substantially all of the pulsating energy which may be imparted to said torsionally resilient drive shaft by the oscillatory motion of said driven member, said torsionally resilient drive shaft having a portion of reduced cross section located between the position on said torsionally resilient drive shaft where said sleeve is affixed and said one end.

3. In a pumping mechanism, a positive displacement fluid pump having high amplitude, low frequency pulsating flow characteristics, said fluid pump having a driven member, said driven member having a bore positioned therein, a sleeve positioned in said bore and affixed to said driven member, a rotatable torsionally resilient drive shaft affixed to said sleeve a substantial distance from one end of said torsionally resilient drive shaft, a source of power operatively connected to said torsionally resilient drive shaft at a point axially spaced from said sleeve for causing said torsionally resilient drive shaft to rotate, said fluid pump imparting an oscillatory motion to said driven member and to said torsionally resilient drive shaft when in operation to impose an oscillatory motion upon its rotary motion, a fluid pump having substantially constant flow characteristics, said fluid pump having substantially constant flow characteristics having a driven pumping means, means operatively connecting said driven pumping means to said one end of said torsionally resilient drive shaft for rotation therewith, the distance between the point where said sleeve is affixed to said torsionally resilient drive shaft and said one end and the torsional resiliency of said torsionally resilient drive shaft being

sufficient to absorb substantially all of the pulsating energy which may be imparted to said torsionally resilient drive shaft by the oscillatory motion of said driven member.

4. A pumping mechanism comprising a rotary pump including an external rotor and an internal rotor having intermeshing lobes, a sleeve affixed to said internal rotor, a rotatable torsionally resilient drive shaft affixed to said sleeve a substantial distance from one end of said torsionally resilient drive shaft, a source of power operatively connected to said torsionally resilient drive shaft at a point axially spaced from said sleeve, said rotary pump imparting an oscillatory motion to said internal rotor and to said torsionally resilient drive shaft when in operation to impose an oscillatory motion upon its rotary motion, driven means affixed to said one end of said torsionally resilient drive shaft and adapted to be driven thereby, the distance between the point where said sleeve is affixed to said torsionally resilient drive shaft and said one end and the torsional resiliency of said torsionally resilient drive shaft being sufficient to absorb substantially all of the pulsating energy which may be imparted to said torsionally resilient drive shaft by the oscillatory motion of said internal rotor.

5. A pumping mechanism comprising a rotary pump including an external rotor and an internal rotor having intermeshing lobes, a sleeve affixed to said internal rotor, a rotatable torsionally resilient drive shaft affixed to said sleeve a substantial distance from one end of said torsionally resilient drive shaft, a source of power operatively connected to said torsionally resilient drive shaft at a point axially spaced from said sleeve, said rotary pump imparting an oscillatory motion to said internal rotor and to said torsionally resilient drive shaft when in operation to impose an oscillatory motion upon its rotary motion, driven means affixed to said one end of said torsionally resilient drive shaft and adapted to be driven thereby, the distance between the point where said sleeve is affixed to said torsionally resilient drive shaft and said one end and the torsional resiliency of said torsionally resilient drive shaft being sufficient to absorb substantially all of the pulsating energy which may be imparted to said torsionally resilient drive shaft by the oscillatory motion of said internal rotor, said torsionally resilient drive shaft having a portion of reduced cross sectional area located between the position where said sleeve is affixed and the position where said driven means is affixed.

6. In a pump mechanism, a rotary pump including an external rotor and an internal rotor having intermeshing lobes, said internal rotor having a bore positioned therein, a sleeve positioned in said bore and affixed to said internal rotor, a rotatable resilient drive shaft affixed to said sleeve a substantial distance from one end of said torsionally resilient drive shaft, a source of power operatively connected to said torsionally resilient drive shaft at a point axially spaced from said sleeve for causing said torsionally resilient shaft to rotate, said rotary pump imparting an oscillatory motion to said internal rotor and to said torsionally resilient drive shaft when in operation to impose an oscillatory motion upon its rotary motion, a vane type pump having a housing and a rotor eccentrically mounted in said housing, means affixing said rotor of said vane pump to said torsionally resilient drive shaft at said one end, the distance between the point where said sleeve is affixed to said torsionally resilient drive shaft and said one end and the torsional resiliency of said torsionally resilient drive shaft being sufficient to absorb all of the pulsating energy which may be imparted to said torsionally resilient drive shaft by the oscillatory motion of said internal rotor of said rotary pump.

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